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## Secondary Effects of Trauma: (Pain) "Sympathetic Dystrophies"

Louis W. Lewis, M.D.\*

**SUMMARY:** Sympathetic Dystrophy or causalgia (pain) is a disability following traumatic injury. It consists of burning pain, glossy sweating, skin changes, and exquisite tenderness caused by tissue damage involving the sympathetic nervous system. Treatment consists of "blocking" the sympathetic nerves to the area by injecting drugs or by surgical repair.

As the item of "pain and suffering" always is a major factor in a lawyer's estimate of the proper amount of a damage award, the medical analysis here presented is of wide interest and utility to lawyers as well as to physicians.

**D**URING THE CIVIL WAR, DR. SILAS WEIR MITCHELL studied nerve injuries in Union soldiers at the United States Army Turner's Lane Hospital in Philadelphia. This was a hospital devoted especially to treating diseases of the nervous system, and was probably the first time a significant number of cases of nerve injury were assembled for study and treatment.

Of this experience, Dr. Mitchell<sup>1</sup> stated: "Slight nerve injuries from pressure, contusion, and partial division by ball or blade, occasion a variety of singular symptoms, which had been little studied before my colleagues and myself saw at Turner's Lane Hospital an unequaled collection."

One of his most important observations resulted in the classic description of Causalgia,<sup>2</sup> which is probably the most important of the conditions now considered as Reflex Sympathetic Dystrophies.

Dr. Mitchell wrote, "In our early experience of nerve wounds, we met with a small number of men who were suffering from a

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<sup>1</sup> Mitchell, Silas Weir, *Injuries of Nerves and Their Consequences*, 153 J. B. Lippincott and Company, Philadelphia (1872).

<sup>2</sup> Mitchell, S. W., Morehouse, G. R., and Keen, W., *Gunshot Wounds and Other Injuries of Nerves*, J. B. Lippincott and Company, Philadelphia (1864).

pain which they described as a 'burning,' or as 'mustard red-hot,' or as a 'red-hot file rasping the skin.'" He went on to state that this condition was frequently associated with glossy skin changes, and that this particular condition of the skin never occurred without the burning pain, and that "We have some doubt as to whether this form of pain ever originates at the moment of wounding; but . . . certain it is that the burning arises later . . . during the healing of the wound. Its favorite site is the foot or hand.

"Its intensity varies from the most trivial burning to a state of torture, which can hardly be credited, but which reacts on the whole economy, until the general health is seriously affected. The part itself is not alone subject to an intense burning sensation, but becomes exquisitely hyperaesthetic, so that a touch or a tap of the finger increases the pain. Exposure to the air is avoided by the patient with a care which seems absurd, and most of the bad cases keep the hand constantly wet, finding relief in the moisture rather than in the coolness of the application. The temper changes and grows irritable, the face becomes anxious, and has a look of weariness and suffering. The sleep is restless, and the constitutional conditioning, reacting on the wounded limb, exasperates the hyperaesthetic state, so that the rattling of a newspaper, a breath of air, the step of another across the ward, the vibrations caused by a military band, or the shock of the feet in walking, gives rise to increase in pain. At last the patient grows hysterical, if we may use the only term which describes the facts. He walks carefully, carries the limb with the sound hand, is tremulous, nervous, and has all kinds of expedients for lessening his pain."

One has only to see these cases to know what a serious problem they present in terms of suffering and disability. Since this condition is usually not considered the direct result of injury, but is a complication in the healing of injured nerves, it may not be manifest for a period of days or weeks after the initial trauma.

At University Hospital we have recorded cases of trauma as apparently insignificant as a bruised groin in an 85 year old woman sustained when she pushed a lawnmower into an obstacle; to numerous fractures and unconsciousness for a month when a 39 year old male's automobile collided with a train. Other cases have ranged from apparently insignificant cuts, to traumatic amputations of extremities; from crush injuries to extremities, from dropping a sledge hammer on the foot, being gored by a cow

horn, fractures from slipping on ice, burns, and gunshot wounds, to numerous other forms of trauma.

There are several conditions other than the classic causalgia that are considered reflex sympathetic dystrophies, but all have in common a history of nerve injury, diffuse burning pain, and changes in the circulation and nutrition of parts in its distribution. It is now well known that this is a reflex phenomenon, initiated by tissue damage, and involving the sympathetic nervous system.

The sympathetic nervous system is that group of nerves which form a chain down either side of the vertebral bodies, and which control constriction of the blood vessels, sweating, dilation of the pupil of the eye, speeding of the heart rate, elevation of the body hairs, the production of "goose bumps," slowing of intestinal activity and cooling of the skin temperature—all phenomena over which we exert little voluntary control, and so called "autonomic." The "sympathetic" division of the autonomic nervous system, which produces all of the above phenomena, is balanced by the parasympathetic division of the autonomic nervous system—the so-called crano-sacral group of nerves.

When the sympathetic nerves to an extremity involved in a reflex sympathetic dystrophy are blocked, sympathetic conduction is stopped, the blood vessels dilate causing warming of the extremity, sweating stops, pain is relieved, and the condition is improved.

The involved sympathetic pathways can be blocked with a local anesthetic agent of short (a few hours) duration; by a drug of up to three months duration (6% aqueous solution of phenol); or fibers and ganglia may be surgically removed for permanent interruption of these impulses. However, as a diagnostic test it is always advisable first to block the pathways in order to prognosticate the effect of surgery, and frequently a single or several sympathetic nerve blocks with a local anesthetic or a single block with 6% phenol will suffice to interrupt the sympathetic reflex and give complete relief.

The natural course of causalgia frequently leads to spontaneous recovery, or to amelioration of the pain to a point where it is tolerable after several months' to a year's incapacity. However, if untreated, or incorrectly treated, the pain can continue, leading to narcotic addiction, psychological depletion, personality changes, prolonged invalidism, wasting of muscles, ankylosis of joints and demineralization of bones (osteoporosis).

Dr. John Mitchell,<sup>3</sup> the son of Silas Weir Mitchell, traced and evaluated as many of the nerve-injury cases as he could who were originally treated by his father during the Civil War, and reported in 1864. The follow-up study was done in 1890-92, providing an interval of 27 to 28 years. Some of these patients still suffered severe burning pain and were partially incapacitated by their causalgia, though most of them had recovered and had the burning pain only in very hot weather or during marked changes in the weather.

Since the tendency in most cases is to improve, a "wait and see" attitude is sometimes resorted to, but cannot be too heartily condemned. Since a rational method of therapy is available, it should be instituted as early as the diagnosis is made, in order that tissue changes will be prevented and rehabilitation will be facilitated. The appropriate sympathetic blocks can be done by most physicians, or by specialists in anesthesiology. If continued short-acting blocks give only temporary relief, then a 6% aqueous solution of phenol should be used for the block, or surgical sympathectomy should be considered.

However, when any attempt is made to interrupt these pathways, there should be objective evidence that this has been done, since blocks sometimes fail to interrupt the intended pathways, and surgeons, too, can fail to completely sympathectomize an extremity.

A simple and convenient test, the Sympatho Galvanic Reflex,<sup>4</sup> or S. G. R., is now used to confirm the fact that the intended pathways have been interrupted—either by chemical or surgical means, and is especially important when there is an apparent failure of the patient to respond to appropriate therapy.

The following case is of interest, and typical of causalgia cases now seen. The patient was a 21 year old male who was in an automobile accident two months previously. He had suffered a ruptured liver, spleen and diaphragm, as well as median and ulnar nerve injury, radial and ulnar arterial injury, and severance of the flexor tendons of the left hand and arm. These injuries had been immediately repaired, but he now had severe pain on motion of the left hand, some burning sensation, cyanosis and sweating, and was thought to have an early causalgia.

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<sup>3</sup> Mitchell, John K., *Remote Consequences of Injuries of Nerves*, Lea Brothers and Company, Philadelphia (1895).

<sup>4</sup> Lewis, Louis W., *Evaluation of Sympathetic Activity Following Chemical or Surgical Sympathectomy*, 34 *Anesth. and Analg.* 334 (1955).

A block of the sympathetic nerves of the left arm was done, using a short-acting local anesthetic agent and S. G. R. control. Adequate block relieved the pain, stopped the sweating, and improved the color and warmth, so 6% phenol was immediately used to prolong these effects. This permitted the patient to have physical therapy and he was gradually rehabilitated, without further symptoms of causalgia.

The minor reflex sympathetic dystrophies are far more common than causalgia, less clear-cut in their symptomatology, and may easily be considered "compensation neurosis" or purely of psychogenic origin because the relation to trauma may be vague. However, pain, usually associated with a vasomotor disorder, should suggest this diagnosis, which is of special importance to those practicing industrial medicine.

The following case illustrates this point: The patient, a 35 year old woman, had an industrial accident that caused her to lose the tip of her right middle finger in a punch press. She had an amputation of the distal phalanx, and two revisions of the amputation during the two years following her accident, and prior to her visit to the University Medical Center. She complained of pain in the stump of the finger, and stiffness and aching of the entire hand. A sympathetic block of the right arm eliminated S. G. R. activity, relieved her pain and permitted increased motion. 6% phenol was then injected, but the pain returned in a couple of days. On re-examination it was found that the block had worn off, and so it was repeated. Again only a couple of days relief was obtained, and so the surgical removal of the sympathetic ganglia was advised. Still there was no relief and the S. G. R. activity was still present, indicating an incomplete operation. Another ganglion was found and removed, but still there was no relief and the S. G. R. activity was still present. The two operations consisted of (1) Sympathectomy of the upper three or four thoracic ganglia by the dorsal approach, (2) Stellate Ganglionectomy (1st thoracic and inferiorcervical sympathetic ganglia).

Under X-ray control<sup>5</sup> a specific block of the 4th thoracic sympathetic ganglion gave pain relief and increased the skin temperature of the right hand by 10 degrees centigrade. This block also eliminated the S. G. R. activity and suggested that removal of T-4 on the right would give prolonged relief. However, since two operations had already been done, the Department of Neuro-

<sup>5</sup> Alexander, F. A. D. and Lovell, B. K., Roentgenologic Control of Nerve Blocks; Use of Iodopyracet Injection, 148 J. A. M. A. 885 (1952).

surgery elected to treat her with analgesic drugs. She still has some pain, but is managing to live with it.

This patient had a low pain threshold, was very anxious about her condition, and the question of industrial compensation entered to complicate the situation. Therefore, it is especially important to have an objective test in order to determine whether or not the sympathetic pathways are intact. This case also demonstrates the point that a scar is not necessarily evidence of a satisfactory surgical procedure.

The matter of compensation is always difficult in pain problems, because it is such a subjective and emotionally charged problem. One of the first to mention this was Dr. John Mitchell,<sup>6</sup> who stated in the introduction to his follow-up of Civil War nerve injuries: "I believe one cause of these troubles (in securing information) to have been the impossibility of convincing the men that my questions were not a device of the Pension Examiners, and that my anxiety to know various minute details of their condition was not prompted by a desire to reduce or take away their pay."

In the most complete modern discussion of the Reflex Sympathetic Dystrophies, Dr. John Bonica<sup>7</sup> stated: "The industrial physician is occasionally confronted by a patient who, following a minor or insignificant injury, complains of severe spontaneous pain, hyperesthesia, and loss of muscle strength, in which the causative factor may be innocuous in appearance, the x-ray studies fail to show bone injury, and tests for muscle function elicit responses which seem inconsistent with the apparent degree of atrophy and condition of the musculature. In such cases it is not unusual for the physician at least to give tacit consideration to some element of compensation neurosis or malingering. This is only natural, particularly for the uninitiated observer or the physician who has been exposed repeatedly to workmen who consciously or unconsciously exaggerate their suffering and the degree of disability in the hope of being given a higher partial permanent disability award when their claim is closed. He may even ascribe the coldness, cyanosis, excessive sweating, swelling, and other objective evidence to "nervousness" or perhaps to prolonged immobilization. Fortunately this is frequently not the case, for physicians with long experience in industrial surgery

<sup>6</sup> See n. 3, above.

<sup>7</sup> Bonica, John J., *The Management of Pain*, 913-978; Lea and Febiger, Philadelphia (1953).

are unlikely to underestimate the reality of reflex dystrophies. Nonetheless, the importance of these disorders cannot be over-emphasized and should always be given proper consideration when the patient's complaints seem to be all out of proportion to the original trauma."

The reflex sympathetic dystrophies are rare, but of great importance when they occur. Usually consequences of trauma, they may lead to prolonged disability if undiagnosed or improperly treated. Early treatment by interruption of the involved sympathetic pathways and physical therapy can prevent serious sequellae.